BULLETIN

OF THE INSTITUTE OF METALS

VOLUME I — MAY 1952 — PART 9

INSTITUTE NEWS

Abstracting of Metallurgical Literature

For some years now the Council of the Institute of Metals has had in mind the desirability in principle of the production of one comprehensive series of metallurgical abstracts in lieu of the individual and independent abstracts produced by the three publishing Institutes. It has been thought that such a combined work would offer great advantages to metallurgists in industry, research organizations, and the universities, while, on the face of it, economies might result. There may be room for doubt on this last count; a directly opposite conclusion has in fact been drawn in some well-informed quarters, but the Council felt that the whole matter merited thorough consideration. An invitation was accordingly issued to the Councils of the Iron and Steel Institute and the Institution of Mining and Metallurgy to nominate representatives to a committee to explore the possibility of joint action in the production of a single comprehensive series of metallurgical abstracts.

The joint committee met on 19 November 1951. The new proposal was agreed to be attractive in principle, but serious difficulties were foreseen. To facilitate further consideration, details of the costs of production of the present abstracts were called for, together with an estimate of the costs of the proposed comprehensive series. One of the participating bodies, however, subsequently confirmed its view that there were special circumstances necessitating continuation of its own abstracts in their present form, whatever the decision on the new proposal. As this would prevent economies in paper, &c., and make the whole scheme financially unsound, your Council has reluctantly come to the conclusion that no further action is desirable at the present juncture.

Election of Members

The following 11 Ordinary Members, 1 Junior Member, and 3 Student Members were elected on 10 March:

As Ordinary Members

Course, Leonard George Odell, Estimating Engineer, The Loewy Engineering Co., Ltd., Bournemouth.

Griffiths, John Henry, Sales Manager, Light Alloy Sales, Richard Thomas and Baldwins, Ltd., 82 Brook Street, London, W.1.

Hassell, Edward James, B.S., Metallurgist, Wright Air Development Centre, U.S.A.F., Dayton, O., U.S.A.

Hillman, Bernard Houndle, Metallurgical Industries Department, Land Commissioner's Office, Düsseldorf, B.A.O.R.4, Germany.

Jestrabek, Otakar, Managing Director, Actid, Ltd., Blantyre Industrial Estate, Blantyre, near Glasgow.

de Jong, J. J., Research Worker, Physical Laboratory, Philips' Gloeilampenfabrieken, Eindhoven, Holland.

Lang, Frances S., M.S., Ph.D., Research Chemist, International Nickel Co., Inc., Bayonne, N.J., U.S.A.

Parks, John M., B.S., Ch.E., Ph.D., Research Metallurgist, Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill., U.S.A.

Potts, Horace Parsons, Managing Director, B.S.A. Tools, Ltd., Marston Green, Birmingham.

Power, Ellen, M.A., Librarian, University College, Dublin.

Ward, Peter, Foundry Manager, John Dale, Ltd., London Colney, Herts.

As Junior Member

Polmear, Ian James, B.Met.E., Research Metallurgist, Fulmer Research Institute, Stoke Poges, Bucks.

As Student Members

Barry-Smith, Thomas, Student of Metallurgy, University of Birmingham.

Lyth, Charles, Student of Metallurgy, University of Manchester.

Walker, Eric A., Student of Metallurgy, University of Manchester.

The following 16 Ordinary Members, 3 Junior Members, and 6 Student Members were elected on 24 March:

As Ordinary Members

Britt, L. O., General Manager, Universal Engineering Co., Ltd., Castle Boulevard, Nottingham.

Cooper, Alex H., B.Sc., A.R.T.C., Metallurgist, 15 Gilchrist Street, Coatbridge, Lanarkshire.

Crawford, Ross, Metallurgist, John Dale, Ltd., London Colney, Herts.

Dodd, Richard Arthur, M.Sc., Ph.D., Senior Professional Officer, Government Metallurgical Laboratory, Johannesburg, South Africa.

Eastlick, John T., M.A., A.B., Librarian, Denver Public Library, Denver 2, Colo., U.S.A.

Ewing, John F., B.S., M.S., Graduate Research Student, University of Michigan, Ann Arbor, Mich., U.S.A.

FITZPATRICK, Christopher, General Manager, Irish Steel Holdings, Ltd., Haulbowline, Co. Cork, Eire.

JACKS, Stanley, B.Sc., Physical Metallurgist, High Duty Alloys, Ltd., Winscales, Workington, Cumberland.

JOHNSON, Arthur Edward, D.Sc., Research Metallurgist, National Physical Laboratory, Teddington, Middlesex.

KASSEM, Mohammed Abd Elaziz, Dipl.Ing.Chem., D.Sc.Tech., Professor of Metallurgy and Chemistry, Farouk I University, Alexandria, Egypt.

MASI, *Dot.* Oscar, Head, Department of Physical Chemistry, Breda Istituto di Ricerche Scientifiche Applicate all' Industria S.p.A., Sesto S. Giovanni, Milan, Italy.

OVERTON, Edwin Maurice, Assistant Director and Chief Metallurgist, Delta Metal Co., Ltd., Dartmouth St., Birmingham 7.

PRICE, William Oswald Weeks, B.Sc., Metallurgical Chemist, The Steel Company of Wales, Ltd., Trostre Works, Llanelly, Carm.

RODHAM, E. J., Commonwealth Aircraft Corporation Pty., Ltd., Lidcombe, N.S.W., Australia.

ROSENBACH, Otto Philipp, Dipl.Ing., Chief Technician, Bonivic Ltd., 125 Old Church Street, London, S.W.3.

SMITH, Oliver Douglas, Chairman and Managing Director, The Maudslay Motor Company, Ltd., Alcester, War.

As Junior Members

BEEBE, Trevor John, Metallurgist, West Brothers (Birmingham), Ltd., Cleveland Street, Birmingham.

WERNER, Richard L., B.Mech.Eng., Student of Metallurgy, Rensselaer Polytechnic Institute, Troy, N.Y., U.S.A.

WERNER, Robert I., B.Mech.Eng., Student of Metallurgy, Rensselaer Polytechnic Institute, Troy, N.Y., U.S.A.

As Student Members

BINDLEY, David, 58 Jackman's Place, Letchworth, Herts.

LINES, John Patrick Clive, Student of Metallurgy, University of Birmingham.

ROURKE, John Warren, B.Sc., Metallurgist, Henry Gardner and Co., Ltd., 2 Metal Exchange Buildings, London, E.C.3.

SMITH, Reginald, Assistant Metallurgist, W. Wesson and Co., Ltd., Victoria Iron Works, Moxley, Staffs.

STACKER, Richard John, Laboratory Assistant, Commonwealth Aircraft Corporation Pty., Ltd., Lidcombe, N.S.W., Australia.

WRIGHT, Peter William, B.A., Technical Assistant, Metals Division, Imperial Chemical Industries, Ltd., Witton, Birmingham 6.

PERSONAL NOTES

DR.-ING. PAUL BRENNER, Director of the Research Laboratory of Vereinigte Aluminium-Werke A.G. and of Vereinigte Leichtmetall-Werke G.m.b.H., Bonn, has been appointed an Honorary Professor in the Technische Hochschule, Hanover.

MR. S. K. GHASWALA has been appointed Technical Editor of a new journal *Industrial Review*. He has also been re-elected Vice-President of the Indian Science News Association.

MR. KENNETH HALL has resigned his position as Managing Director of the Northern Aluminium Co., Ltd., to take up an appointment in the head office of the Aluminum Group of Companies in Montreal, Canada. Mr. Hall is succeeded by Mr. Fraser W. Bruce.

DR. J. H. HOLLOMON has been appointed Manager of the Metallurgy Research Department of The General Electric Company, Schenectady, N.Y.

PROFESSOR AXEL HULTGREN (Honorary Corresponding Member to the Council for Sweden) has retired from his Professorship at the K. Tekniska Högskolan, Stockholm, on reaching the age limit for the post. He will, however, be acting Professor, pending the appointment of his successor within the next few months. Professor Hultgren's future address will be Valevägen 49, Djursholm 2, Sweden.

MR. B. M. LYNCH has been awarded the B.Sc. degree of Melbourne University, with first-class Honours in Chemistry and third-class Honours in Metallurgy. He has now taken up a research studentship in the Department of Chemistry at the University.

MR. JOHN RAE, Jr., Joint Managing Director of McKechnie Bros. South Africa (Pty.), Ltd., has been elected Chairman of the newly formed South African Wrought Non-Ferrous Metal Manufacturers' Association, Johannesburg.

MR. H. F. SHERBORNE has been appointed General Manager of The Yorkshire Copper Works, Ltd., Leeds. He has been a Director of the Company for 21 years.

MR. P. SPEAR has left B.S.A. Tools, Ltd., to take up an appointment with Rubery, Owen and Co., Ltd., Darlaston.

MR. E. C. SYKES has left The de Havilland Aircraft Co., Ltd., to take up an appointment in the Metallurgy Department of the Atomic Energy Research Establishment, Harwell.

Birth

RHODES. On 8 March 1952, at Queen Charlotte's Hospital, London, to Edwin and Elizabeth Rhodes, a daughter—Anne Elizabeth.

PERSONALITIES

Mr. W. S. Robinson

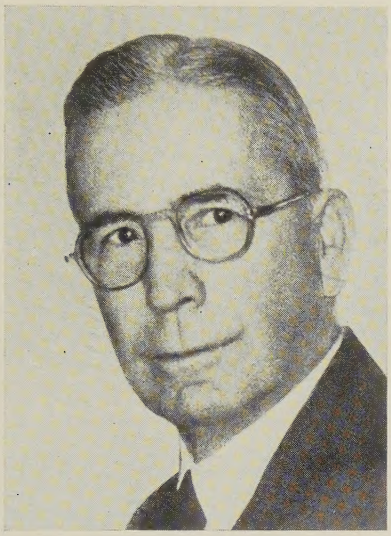
(Institute of Metals (Platinum) Medallist 1952)

William Sydney Robinson was born in Melbourne in 1876 and educated in Australia. After a short period in which he engaged in farming and fruit growing, Mr. Robinson in 1896 joined the staff of the Melbourne daily newspaper *The Age*, and four years later succeeded his father as Financial Editor of the paper. In 1905 he abandoned this career and turned his attention to mining and metallurgy. He became interested in the Broken Hill Mines and took an active part in the development of a wet flotation process for concentrating sulphide ores and in finding means of recovering zinc from the residues of the lead mills.

In 1906 and again in 1907 Mr. Robinson carried out wide investigations of all important Australian mining fields and the undeveloped areas of north-western Queensland and the Northern Territory. He was then offered, and accepted, a partnership in the London financial house of Lionel Robinson, Clark and Co., being detailed to assist in providing capital for the development and equipment of Broken Hill and other Australian mining fields and for industries primarily dependent on Australian raw materials.

Mr. Robinson was domiciled in England from 1908 till the end of 1949, when he returned to live in Australia, and he was for a time a member of the London Stock Exchange. On the outbreak of World War I he was immediately placed in charge of important Broken Hill interests, and early in 1915, with the

Hon. W. L. Baillieu, he formed the Broken Hill Associated Smelters Pty., Ltd., to acquire control of the Port Pirie smelting plant of the Broken Hill Proprietary Company. These works were rapidly extended to treat on a co-operative basis the whole of the silver-lead concentrates of the Broken Hill field, and quickly became the largest non-ferrous metal smelters



in the British Empire. He also took a leading part in establishing electrolytic zinc production in Australia.

In 1915 Mr. Robinson was appointed by the Rt. Hon. W. M. Hughes to act as his adviser in London on non-ferrous metals and particularly the development of the zinc metal industry in both Australia and Britain and metal manufacturing within the Commonwealth. He and Mr. W. L. Baillieu were awarded in 1929 the Gold Medal of the British Institution of Mining and Metallurgy to mark their efforts to establish the zinc industry in the United Kingdom and Australia.

Mr. Robinson negotiated the war contracts between the Australian producers and the United Kingdom Government for all non-ferrous metals surplus to local requirements, and was placed in charge of all overseas shipments and distributions of Australian non-ferrous metals for the duration of the War. At the end of World War I he was selected by the leading producers to control in London the sale, distribution, shipment, and extension of the uses of Broken Hill products surplus to Australian requirements.

Mr. Robinson was closely associated with the formation of The Zinc Corporation, Ltd., in 1905 and its subsequent activities in Australia. He was also associated with the purchase of the South Blocks Mine, which later became the mining department of the Zinc Corporation. In 1920 he joined the Board of the Corporation, and later he succeeded Mr. H. C. Hoover as Managing Director, a position he held until his retirement in 1949. He remained as President of the Company until the end of 1951.

Between the wars Mr. Robinson represented the Commonwealth of Australia at the International Labour Conference in Geneva in 1921, and was present at the Ottawa Conference in 1932. In 1923, he brought British and Australian interests together in a major effort to establish the zinc smelting industry in the United Kingdom. This involved first the acquisition of the National Smelting Co., Ltd., (1923), and the subsequent formation of Imperial Smelting Corporation, Ltd. (1929). He acted as Managing Director of the National Smelting Company and Director of Imperial Smelting Corporation up to 1949. On the formation of the important Consolidated Zinc Corporation, which completely absorbed the Zinc Corporation, New Broken Hill Consolidated, the Sulphide Corporation (Australia), &c., and acquired all the ordinary shares of Imperial Smelting Corporation, he was made President, a position he occupied until his retirement on 31 December 1951.

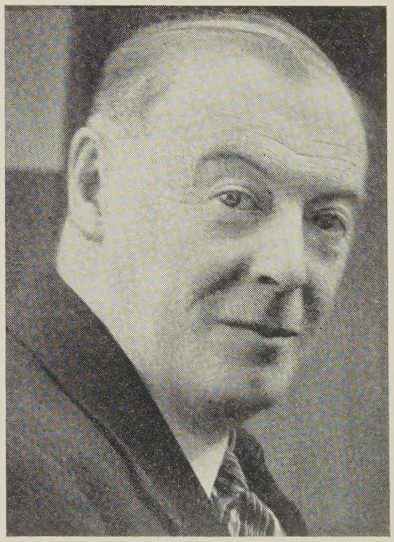
In World War II the Prime Minister of Australia appointed Mr. Robinson a Government Adviser, and he accompanied the Minister for External Affairs, Dr. H. V. Evatt, on many of his important missions. While chiefly resident in London and Washington, he made frequent visits by air to Australia. Throughout the war all negotiations and major contracts for the sale and shipment of Australian non-ferrous metals were under his direction.

Mr. Robinson was largely instrumental in the building up of many important industries in Australia with the aid of British capital and manufacturers, particularly in non-ferrous metals, copper wires, rods, cables, paints and pigments, paper, textiles, aluminium, aircraft, &c. He was one of the pioneers of the titanium oxide industry, both in the United Kingdom and Australia, and his name will always be associated with the efforts to revive and maintain the Australian gold-mining industry. In 1950 he was awarded the Medal of the Australasian Institute of Mining and Metallurgy for services to these industries and for his efforts to develop Australia.

Mr. C. E. Davies

(W. H. A. Robertson Medallist 1952)

Cyril Ernest Davies was born in London, educated at Whitgift School, Croydon, and received his practical training at the Elswick works of Armstrong Whitworth and Co., Ltd., Newcastle-upon-Tyne. Later he became a leading



draughtsman with W. H. Allen, Sons and Co., Bedford, and after a period as Chief Engineer in charge of the estimating department of Fullerton, Hodgart and Barclay, Ltd., Paisley, Mr. Davies joined W. H. A. Robertson and Co., Ltd., Bedford, in 1907. During the 1914–18 war, Mr. Davies was a technical officer attached to H.M.S. *Vernon*, and subsequently to the mining school at Portsmouth, where he was

in charge of experimental and design work in connection with submarine mines and mine-layers. Returning to Bedford in 1919, Mr. Davies took charge of the rolling-mill department, and was later appointed a Director of the Company.

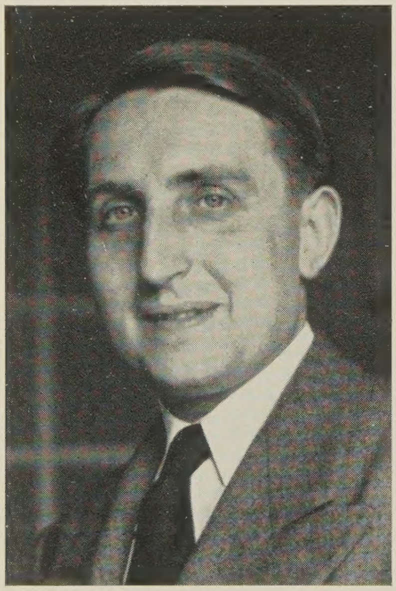
Mr. Davies has made an extensive study of the theory of the rolling process, and has originated a practical method of calculating roll pressures, power, &c., on which to base mill design, in place of the old "rule-of-thumb" methods. He has also investigated experimentally the subject of "spread" in rolling, and devised a formula of particular value in wire flattening, to which reference was made in later German work. With Mr. A. J. Bourne, Mr. Davies originated and developed the well-known "flood-lubrication" roll bearing, which was the first oil-film-lubricated bearing for rolls, and was the forerunner of other bearings on this principle later developed in the U.S.A. He has been a pioneer of the practice of high speeds for cold-rolling mills, and was responsible for the design and construction of the first four-high rolling mill built in this country.

In the course of his work, Mr. Davies has visited most European countries, including Russia in 1936. He has read numerous papers on the theory and practice of rolling and on rolling-mill design before scientific societies and made many contributions to the technical press.

Mr. Davies is a Member of the Institution of Mechanical Engineers and of the Rolling Committee of the British Iron and Steel Association. He joined the Institute of Metals in 1921, and has served on the Metallurgical Engineering Committee.

Professor André Guinier
(Rosenhain Medallist 1952)

André Guinier was born at Nancy in 1911 and entered the Ecole Normale Supérieure, Paris, in 1930, where he worked under Professor Ch. Mauguin, presenting his thesis in 1939.



After the war, he became Head of the Physics Department at the Laboratoire d'Essais du Conservatoire National des Arts et Métiers, and remained there until 1948 as Deputy Director. At present, M. Guinier is Professor of Physics at the Sorbonne and also is in charge of a course in X-Ray Technique and the Structure of Metals at the Conservatoire National des Arts et Métiers.

M. Guinier's researches have been directed principally to the X-ray study of imperfect crystals. Since the effects of imperfections on the X-ray photographs are usually only slight, improved techniques have had to be devised, using strictly monochromatic radiation, diffraction at very small angles, and focusing Laue diagrams.

Apart from some measurements of the size of colloidal particles by diffraction at small angles, these techniques have been mainly devoted to the study of metallic crystals. Among the problems investigated have been the structure of age-hardened alloys (in the systems Al–Cu, Al–Ag, Al–Mg–Si, Cu–Be, &c.), the structure of solid solutions during order–disorder transformations (in the Au–Cu and Au–Ag systems), and the polygonized state in metals. This work has been the subject of numerous papers, including one in 1939 in the *Journal* of the Institute of Metals.

In the field of electron microscopy, M. Guinier has devised, in conjunction with M. R. Castaing, an apparatus with an electronic probe, which will enable a qualitative and quantitative analysis of a metallic specimen to be made on a surface of the order of 1 micron.

LETTERS TO THE EDITOR

Low-Stress Torsional Creep Properties of Pure Aluminium

The work of Kê[1] on the internal friction of polycrystalline metals led to the conclusion that a well-marked peak in the curve relating damping to temperature was due to the viscous behaviour of grain boundaries. Constant-stress creep studies carried out in torsion on similar samples of high-purity aluminium were interpreted by Kê as being due to a similar mechanism, the decreasing creep rate with time resulting from the elastic restraint of the grains reducing the effective shear stress on a grain boundary. A close study of the creep curves obtained by Kê, however, suggests that there are anomalies in such a picture. For a sample consisting of equiaxed polyhedral grains of a uniform size, with a constant grain-boundary viscosity, the proposed mechanism leads to an exponential creep curve asymptotic to a strain value approximately 1·5 times the elastic strain. Kê's curves are very far from such a shape, and although they are claimed to show evidence of flattening out at about 1·5 times the elastic strain, this is not at all convincing. Although the shape of the observed curves might be explained on the basis of the proposed mechanism by assuming a distribution function for either the grain-size or the viscosity of the boundaries, or both, very wide and unlikely distributions would be required.

In order to investigate the problem further, torsion–creep curves have been determined on super-purity aluminium (99·99%), in a manner essentially similar to that adopted by Kê, except that $\frac{1}{4}$-in.-dia. test rods were used instead of 0·033-in.-dia. wire. This has the advantage that relatively coarse-grained samples can be used without the grain diameter becoming comparable to the diameter of the sample. The stress adopted was such as to produce an elastic shear strain of 3×10^{-5} in the surface of the specimen, and the optical strain-measuring system was accurate to about 3×10^{-7}. The rod was produced with a 95% reduction in area by cold work, and samples were annealed for 1 hr. each at temperatures varying between 300° and 600° C. This produced grain

diameters varying between 0·07 and 1·19 mm. The creep curves then obtained, at a constant stress at 200° C., are shown in Fig. 1. If the differences in the creep curves were due solely to the different grain-sizes, the curves should be identical

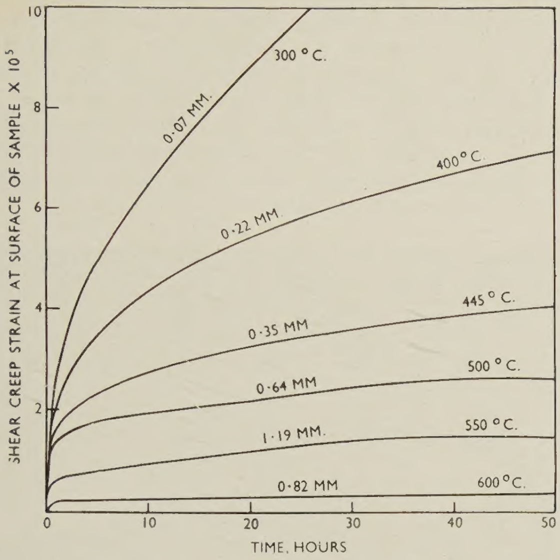


FIG. 1.—Torsion Creep Curves for Pure Aluminium at 200° C. Mean grain diameter and annealing temperature are indicated on each curve.

except for a factor in the time scale linearly proportional to the grain diameter. It was found that the curves could not be fitted in this manner, but the ratios of the times to produce a creep strain of $1·4 \times 10^{-5}$ are given in Table I, and it is

TABLE I

Annealing Temperature, °C.	300	400	445	500	550	600
Mean Grain Diameter, mm.	0·07	0·22	0·35	0·64	1·19	0·82
Time Factor at Strain of $1·4 \times 10^{-5}$	0·54	1·00	1·82	4·07	141	...

clear that the time factor is not linearly proportional to the grain-size. If the observed creep is due entirely to grain-boundary flow, it is necessary to assume that the effective viscosity is dependent on the annealing treatment. Kê [2] has already suggested that with a constant annealing treatment the viscosity is dependent on the previous cold-working history of the sample.

Kê's evidence for the observed creep strain being due to viscous grain-boundary flow was based mainly on two observations: (1) no creep was detected in a " single crystal " of commercially pure aluminium, and (2) the position of the peak in the internal-friction curve was dependent on the grain-size of the sample, the change in grain-size being produced by change in annealing temperature. Kê [2] has shown that the impurities in commercial aluminium tend to block intercrystalline flow, and since the results on super-purity aluminium described above have shown that in polycrystalline material a high annealing temperature reduces the creep to very small proportions (and presumably Kê's crystal, whether produced by strain-annealing or from the melt, was subjected to an effective high-temperature anneal), it appeared possible that the lack of creep in Kê's single crystal might be due to factors other than the virtual absence of grain boundaries. Accordingly, a ¼-in.-dia. single crystal of super-purity aluminium was grown from the molten state, and this was found to give no creep when tested in a manner similar to that used for the polycrystalline rods, either in the initial fully annealed condition or after 2% plastic strain in tension. This result confirms Kê's conclusion that no creep is observed in the absence of grain boundaries, even when the material is imperfectly annealed.

We thus reach the conclusion that in super-purity aluminium creep under low torsional stresses occurs only in polycrystalline material; but if it is to be explained as a consequence of viscous flow at the grain boundaries, the effective viscosity must vary very widely from boundary to boundary in a single specimen and must depend on both the previous cold-working history and the annealing treatment applied to the specimen. Alternatively, the grain boundaries may be sources of easily-moved dislocations, which give rise to creep by initiating slip within the grains, and it is readily understandable, in a qualitative manner, that the number and ease of movement of such dislocations might depend very markedly on the prior history of the specimen.

A more complete investigation of the effects of cold work and annealing on the creep behaviour is in hand.

The writer's thanks are due to The Mond Nickel Co., Ltd., for permission to publish this note.

W. BETTERIDGE.

The Mond Nickel Co. Ltd.,
Development and Research Dept. Laboratory,
Birmingham 16.

REFERENCES

1. T. S. Kê, *Phys. Rev.*, 1947, [ii], **71**, 533.
2. T. S. Kê, *J. Appl. Physics*, 1949, **20**, 274.

The Resolution of the Metallurgical Microscope

It is well known to the metallurgist, using the visual-light microscope, that a limit is set to the useful magnification which can be employed, and that this limit is controlled by the numerical aperture of the objective and the wave-length of the illuminating beam. For visual work this limit is empirically fixed at about 500 × N.A. or, say, 700×, though it is not unusual to photograph at magnifications considerably in excess of this figure.

It may happen that important details in the specimen are not fully resolved at 700× and that higher magnifications are desirable without resort to the electron microscope. What then can be done to increase the resolution and hence the useful limit of magnification?

The numerical aperture (N.A.) of the objective can be increased only with considerable difficulty, and this entails the use of troublesome immersion fluids such as mono-bromo-naphthalene. It is possible, however, since resolution is inversely proportional to wave-length, to utilize radiations of shorter wave-length and in this way to bring about a very considerable increase in resolution.

The sources of light in general use are the carbon-arc, the Pointolite, and the high-pressure mercury lamp, which cover the visual spectrum extending from 400 to 760 μ. The eye is most sensitive to yellow-green light of wave-length, 550 μ, and this value is generally taken when working out the theoretical resolving power of objectives designed for visual use.

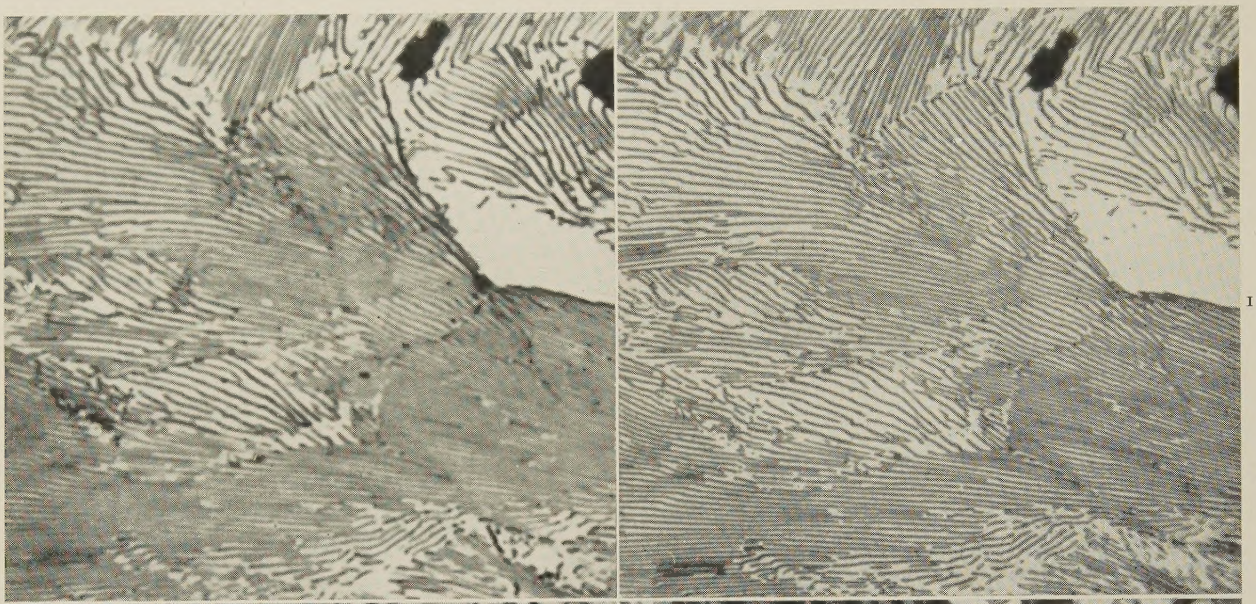
On moving towards the shorter wave-lengths, the eye becomes progressively less sensitive, until at about 400 μ all sensitivity ceases. Fortunately, however, the photographic plate still reacts strongly down to 200 μ in the ultra-violet and several suitable sources are available.

As metallurgical specimens must be illuminated by reflected light, bright sources are essential if exposures are not to be very prolonged, and hence the number of possible sources is restricted. In order of intensity they are as follows: (*a*) magnesium 280 μ, (*b*) cadmium 275 μ, (*c*) aluminium 223 μ.

Because of the lack of suitable materials transparent to these wave-lengths, the objective must be a monochromat, and the radiations should be as nearly as possible of one wave-length. For this reason magnesium is not suitable and cadmium becomes the best choice. Using the cadmium spark as a source, we may expect to double the resolution of the metallurgical microscope.

If current is taken from the mains at 230 V. and 50 c./s. and transformed to 10,000 V. or more, it can be fed to two cadmium electrodes with a condenser of 0·01 microfarads in parallel. If the electrodes are separated by about 2 mm., 100 sparks/sec. will jump the gap and sufficient heat may be generated to melt the electrodes. If, however, two discs of cadmium about 3 in. in dia. are caused to rotate at high speed, the overheating may be avoided and a very bright spark will be available as a source of illumination.

1(*a*) 1(*b*)



2(*a*) 2(*b*)

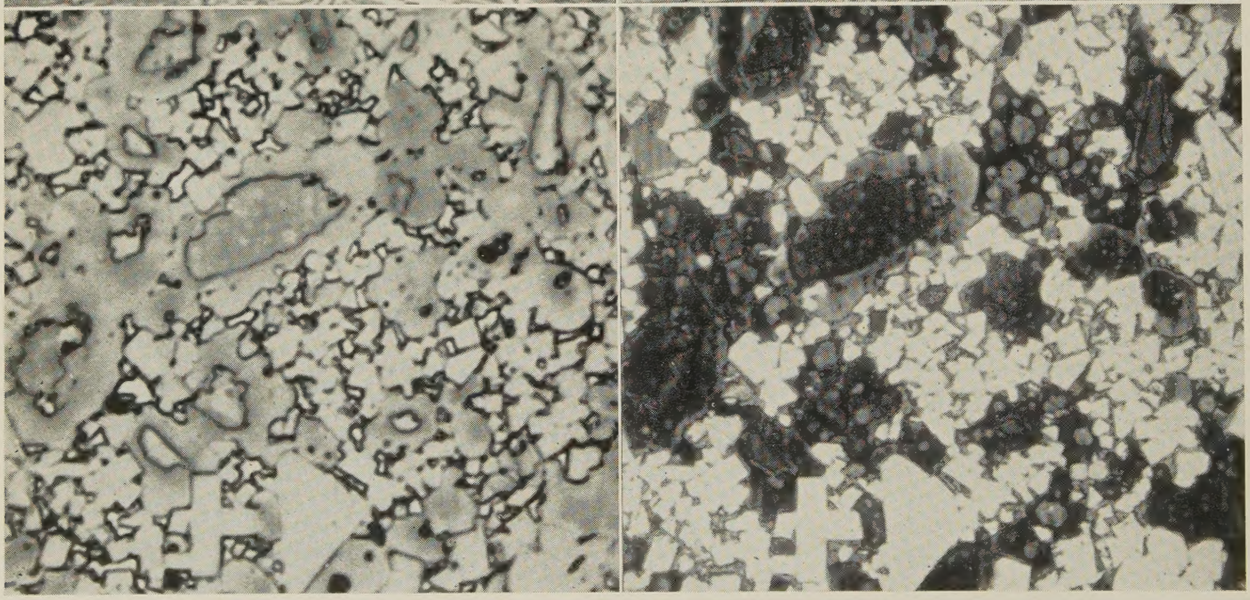


FIG. 1.—Lamellar Pearlite. Etched in 1% Picral. × 2500.
FIG. 2.—Sintered Carbides (Wimet). Etched in Murakami's reagent. × 2500.

(*a*) Objective: Cooke 2 mm. Fluorite. N.A. 1·3.
Eyepiece: × 4. Compensating.
Illumination: Normal incident. High-pressure Hg-vapour lamp.
Filter: OGr 1.

(*b*) Objective: Cooke 2 mm. Monochromat. N.A. 1·25.
Glycerine immersion.
Eyepiece: × 10. Quartz.
Illumination: Normal incident.
Cadmium spark 2750 Å.

In order to eliminate radiations of other wave-lengths, for which the objective is not computed, it is advisable to pass the light through two quartz 60° deviation prisms before feeding it to the microscope. As light of 275 μ is absorbed by glass, all the optical parts, including the objective, cover-glass reflector, and eyepiece must be replaced by fused or natural quartz.

The image formed in the ultra-violet may be made visible by means of a fluorescent screen fixed in the focal plane. This gives rise to sufficient visual light to enable the image to be focused, and at the same time the eyes can be protected from harmful radiations by a suitable filter. Finally, the fluorescence eyepiece is removed, a quartz eyepiece substituted, and a photograph obtained.

Although a description of the procedure is necessarily somewhat lengthy, the technique is not difficult. When taking Figs. 1 and 2, a Vickers Projection Microscope was used, in which all glass parts were replaced by quartz. The source of the ultra-violet radiations was a self-contained unit mounted on a pillar to one side of the instrument.

It will be seen from the photographs, if detail is not lost in reproduction, that the halved wave-length of the ultra-violet does in fact give rise to doubled resolution. It will also be observed that certain structures may be picked out from their surroundings by differential absorption, as in Fig. 2 (*b*), and this may be a further valuable feature of this technique.

The object of this letter is to indicate how the resolution of the metallurgical microscope may be increased and to invite metallurgists who have come across structures which are beyond the resolving power of the normal visual microscope to send them to us as test objects for the ultra-violet microscope. The technique is not in itself new.[1, 2]

E. Wilfred Taylor.

Cooke, Troughton, and Simms, Ltd.,
York.

REFERENCES

1. F. F. Lucas, *Trans. Amer. Inst. Min. Met. Eng.*, 1926, **73**, 909.
2. J. Smiles and H. Wrighton, *Proc. Roy. Soc.*, 1937, [A], **158**, 671.

The Training and Status of Metallurgists

Mr. Chadwick's address on " The Training and Status of Metallurgists " (*Bulletin*, 1952, **1**, (6), 42) raises many points of immense importance. We are living in an age in which education in general, both in theory and in practice, is in the melting pot, and this is particularly true of education for the technologies. It is inevitable, therefore, that there must be somewhat acute differences of opinion.

In considering technological education in this country, undue weight appears to the writer to have been given to the achievements of the Massachusetts Institute of Technology. This is beyond doubt an institution of the highest standard and of world-wide reputation, but it does not follow that because it meets the needs of the United States it should necessarily be the ideal for technological education in this country. It is not sufficiently recognized here, for instance, that the fees are to our way of thinking extremely high—roughly of the order of £275 a year, or say five to six times as much as a provincial University in this country; nor is it recognized that the wastage of students during the first year is very much higher than that in corresponding educational institutions here. Further, a not inconsiderable proportion of the undergraduate teaching is done by newly qualified research assistants, and there is, I believe, in some circles a feeling of concern with regard to the quality of such instruction. It should be remembered, too, that the M.I.T. performs two somewhat distinct functions. It corresponds to a technological university, but at the same time performs some, at any rate, of the functions of our own Department of Scientific and Industrial Research, and with the speeding up of rearmament, this latter function is becoming increasingly important. All this must not be taken as being a criticism of an outstanding educational establishment, but as an attempt to indicate that it may have received undue prominence in educational discussion on this side of the Atlantic.

All concerned with metallurgical education in this country will have read with the most marked agreement Mr. Chadwick's words about the writing of reports. More than one University has been compelled to introduce some sort of essay and report-writing course as part of its curriculum.

Although this does not come immediately into the field of Mr. Chadwick's discussion, it is the writer's belief that the general build-up of technological education in this country is broadly satisfactory. This does not mean in the least that improvements cannot, and should not, be effected. One direction in which such improvement is long overdue is in the equipment, staffing, and outlook of the best of the technical colleges. The natural function of these colleges, though different from, is as important as that of the University technological departments themselves, but I do believe, and believe strongly, that the functions of the two are essentially different. If in these days of austerity and economy more money is available for technological instruction, although the Universities themselves will need some of this, one of the very best ways in which it could be spent is by building up a few really first-rate technical colleges. This could be done at a small fraction of the cost which would be required for the establishment of an " English M.I.T.", and once the technical colleges had appreciated—as I am afraid they do not at the moment always appreciate—the fact that their function is different from that of the university, to which, I think, is due the inferiority complex which often oppresses them, we should have in England a fabric of technological teaching not inferior to that to be found anywhere else in the world.

I have used hitherto the word " teaching " in a double sense : for both the sort of instruction that it is proper to give at the undergraduate or immediate postgraduate level and also for instruction in research and research methods. Technological research in the technical colleges could, and should, be developed to a much higher level. The mere installation of expensive and elaborate machinery is, however, not sufficient. Such machinery gets out of date relatively quickly, and one could point to only too many colleges which are now almost littered with pieces of plant which have little more than historical interest. Technological research, however, has as at any rate one of its functions the development and application of plant on a scale which few, if any, Universities either could, or perhaps should, contemplate. Here again the distinction between the type of research proper to the University and that which can equally properly be carried out in the technical colleges is fairly clearly, though not of course exactly, demarcated.

I may summarize, therefore, these views—which are largely heretical, and with which many colleagues would not be by any means in complete agreement—by saying that, as I see it, the national economy demands two forms of technological instruction, each of equal importance. That in the Universities is already well recognized and needs no further emphasis here. In the best of the technical colleges both the nature of the teaching and the nature of the research, though different

in outlook from those of the Universities, need an adequate chance of considerable development on their own lines. If this point of view is once accepted, both the Universities and the technical colleges can work together in complete harmony for the good of the national industries as a whole.

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NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

London Local Section

At a meeting of the Section held at 4 Grosvenor Gardens, London, S.W.1, on 7 February, Dr. A. H. SULLY, Principal Physicist to the Fulmer Research Institute, lectured on:

Chromium and Chromium-Rich Alloys

The methods of producing chromium and ferro-chromium were briefly reviewed, and the impurities commonly present in commercial chromium were considered. The major impurities in electrolytic chromium were hydrogen and oxygen. Whereas the former could be eliminated readily by heating, elimination of the latter was more difficult. The mode of occurrence of the oxygen and its estimation were discussed. Purification techniques for chromium and the production of high-purity chromium-rich alloys were described.

A survey was then made of the high-temperature properties of these alloys. Although some were highly resistant to deformation at high temperature, the major obstacle to their industrial use was their brittleness at room temperature, a feature shown also by pure metallic chromium. The lecturer said that chromium, like iron, underwent a sharp transition from brittleness to ductility over a small temperature range. In addition, recent work had shown that chromium underwent a transition at about 37° C., which was accompanied by marked changes in electrical resistivity, dilatation, elastic modulus, and internal friction, although the crystal structure did not alter and the lattice constant showed no anomaly. The lecturer speculated on whether a change in cohesion, favouring cleavage failure at lower temperatures, might accompany this transition. Although the factors affecting the ductility of chromium were still being investigated, it did not appear likely that creep-resistant chromium alloys having any substantial degree of ductility at room temperatures would emerge.

At a meeting of the Section held at 4 Grosvenor Gardens, London, S.W.1, on 6 March, Major P. LITHERLAND TEED, Deputy Chief of Research and Development, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, gave an address entitled:

Some Metallurgical Problems Imposed by Stratospheric Flight

The lecturer first described the physical structure and chemical composition of the atmosphere from ground level up to the lower stratosphere. The aerodynamic and thermodynamic reasons making stratospheric flight attractive were outlined, and the metallurgical make-up of a modern high-altitude aeroplane was given.

Two chemical aspects of stratospheric flight were then considered. The astonishing rate of wear of the carbon brushes of dynamos and motors at stratospheric heights, which may be as high as $\frac{3}{8}$ in./hr., was discussed and remedial measures suggested. The second chemical case arose from the necessity for supplying all personnel within a stratospheric aircraft with pressurized, humidified air. Owing to the condensation of moisture on the interior surfaces of aircraft travelling at subsonic speeds, corrosion and contact-corrosion difficulties had to be guarded against.

The concluding portion of the lecture dealt with the influence of temperature on the exposed portions of aircraft flying at stratospheric heights. This depended very greatly on the speed of flight. At a mere 8–9 miles/min., the surface temperature was about that of the ambient air, which might, however, be as low as $-70°$ C. On the other hand, if the speed were twice the local velocity of sound, it would be as high as $+118°$ C., and at three times this speed (approximately 2000 miles/hr.), surface temperatures would be over 330° C. The influence of such temperatures on the static and dynamic mechanical properties of the alloys currently used in aircraft was considered in detail.

Scottish Local Section

At the meeting of the Section held in Glasgow on 10 March, two short papers were presented and discussed.

The first of these, given by Mr. A. CRAIG MACDONALD, was entitled "Back to Ductility". Mr. Macdonald considered that existing tests were not very satisfactory when applied to alloys of low ductility, notably some light alloys which may be used for structural parts of machinery. He described how the suitability of the material could be usefully assessed by hammering it to destruction. The paper gave rise to a very lively discussion.

Afterwards Mr. A. E. WAKELING spoke on "Manganese Bronze," outlining the range of compositions employed and the relationship between composition, microstructure, and mechanical properties. A good discussion followed.

DIARY

Other Societies

7 May. Institution of Production Engineers, Norwich Section. "Advance of Industrial Heat-Treatment", by J. McHenry. (Room 15, St. George's Street Building, Norwich City College, Norwich, at 7.30 p.m.)

8 May. Institution of Electrical Engineers. "The Use of Electricity in a Modern Iron and Steel Works", By W. F. Cartwright. (The Institution, Savoy Place, London, W.C.2, at 5.30 p.m.)

14 May. Society of Chemical Industry, Corrosion Group. Papers on "The Prevention of Corrosion in Packaging". (Chemical Society, Burlington House, Piccadilly, London, W.1, at 6.15 p.m.)

15 May. Institution of Mining and Metallurgy. General Meeting. (Geological Society, Burlington House, Piccadilly, London, W.1, at 5.0 p.m.)

19 May. Institute of Metal Finishing, London Centre. "Electrodeposition of Zinc", by R. W. Bailey. (Northampton Polytechnic, St. John Street, London, E.C.1, at 6.0 p.m.)

22 May. Institution of Production Engineers, Wolverhampton Graduate Section. "Principles of Drop, Press, and Upset Forgings", by J. D. Gutteridge. (Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton, at 7.30 p.m.)